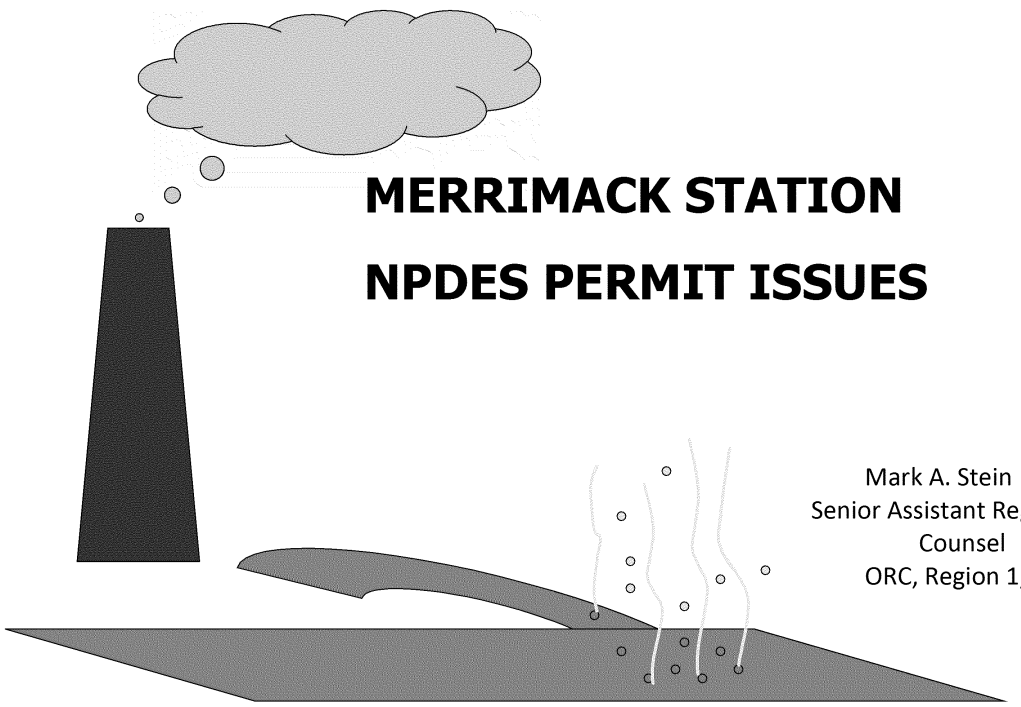


MERRIMACK STATION

NPDES PERMIT ISSUES

Mark A. Stein
Senior Assistant Regional Counsel
ORC, Region 1, US EPA

Facility Background

- Merrimack Station owned by Public Service Company of New Hampshire (PSNH)
  - PSNH owned by Northeast Utilities
- Burns coal
- Generates ~478 MW from two primary units
  - Unit 1: ~120 MW; commenced operations in 1960
- Unit 2: ~ 350 MW; commenced operation in 1968
- New Hampshire not de-regulated
  - PSNH still recovers costs through customer rates, as approved by NH PUC
- From 2006-2009: Unit 1 ran 89% of time; Unit 2 ran 77% of time
- Overall decreased capacity utilization since 2011 due to cheap natural gas

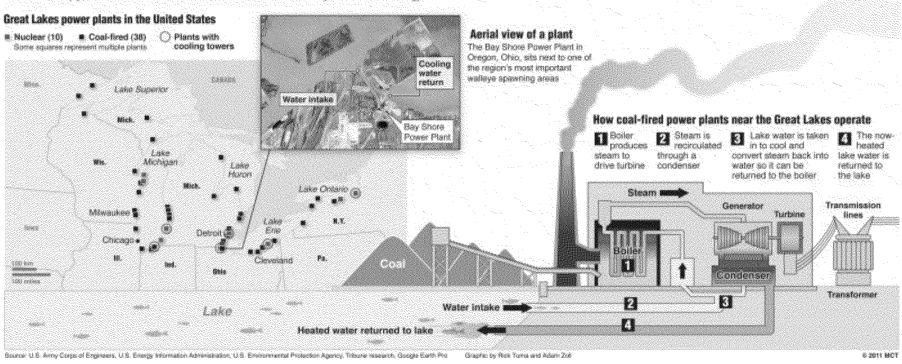
State of New Hampshire

Merrimack Station NPDES Draft Permit: 3 Key Environmental Issues

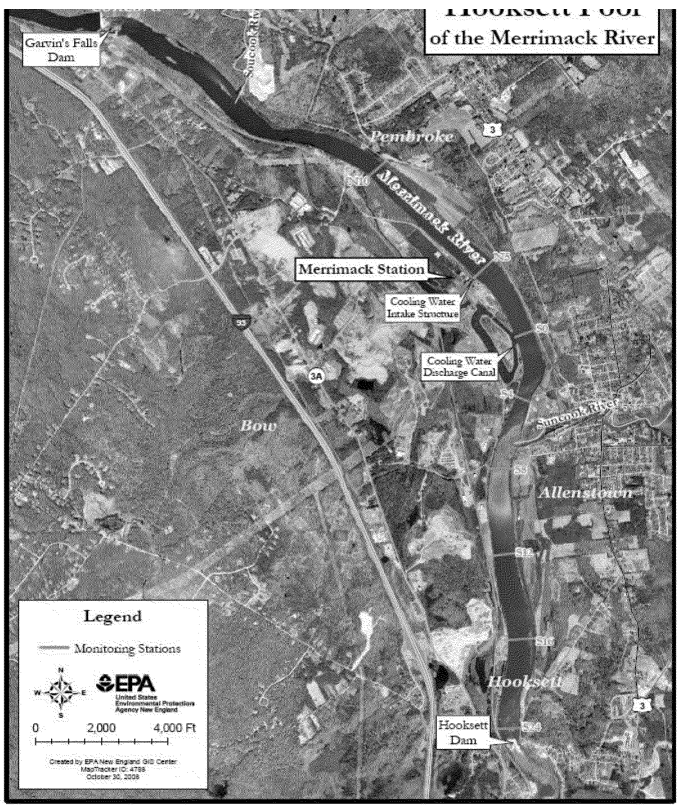
- Thermal discharge effects on aquatic community – CWA §316(a)
- Cooling Water Intake Structure (CWIS) impacts – CWA §316(b)
- Pollutants (mostly metals) removed from stack flue gas by the new FGD system can enter the Flue Gas Desulfurization Wastewater Treatment System (FGD WWTS)

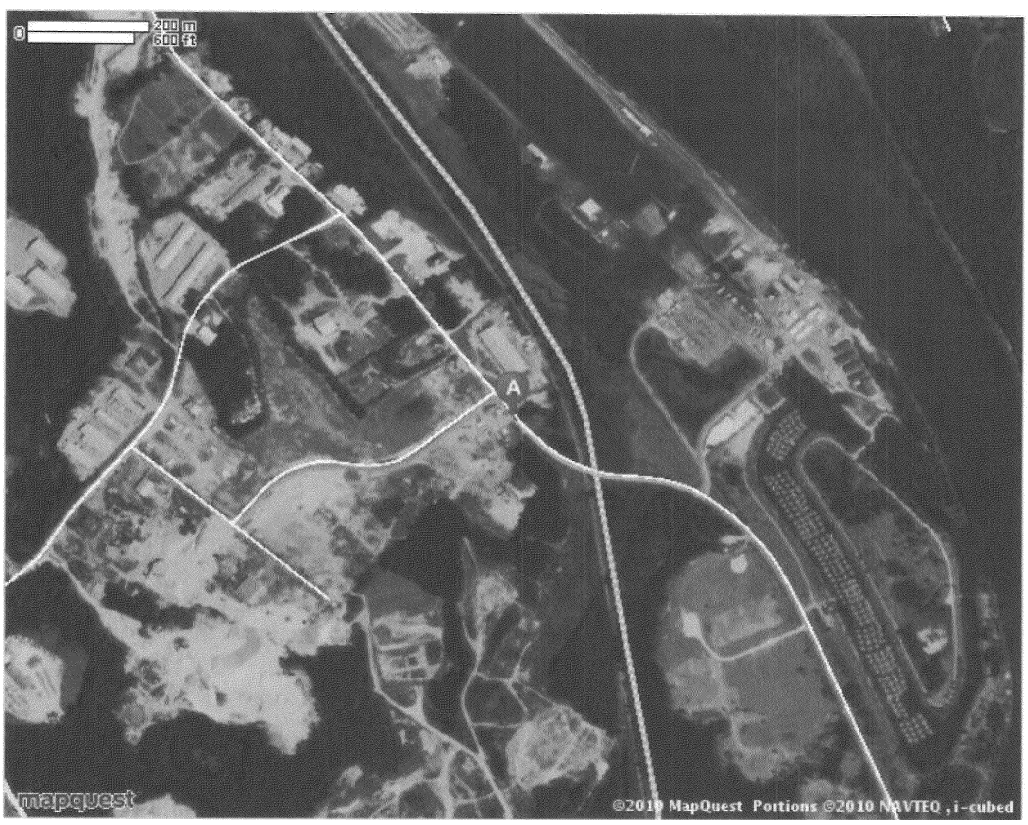
Power plants a double threat to fish

Dozens of power plants on the Great Lakes suck up massive amounts of water to cool equipment. The cooling systems, which are so powerful that most could fill an Olympic-sized swimming pool in less than a minute, kill millions of fish pulled against intake screens. Billions more eggs, larvae and other organisms are killed by intense heat and high pressure inside the plants. Newer plants use cooling towers that sharply reduce water withdrawals, but most on the Great Lakes still rely on the older technology.



Source: U.S. Army Corps of Engineers, U.S. Energy Information Administration, U.S. Environmental Protection Agency, Tribune research, Google Earth Pro Graphic by Rick Tuma and Adam Zoll


Hooksett Pool
of the Merrimack River
Garvin's Falls Dam
Pembroke
Merrimack River
Merrimack Station
Cooling Water Intake Structure
Cooling Water Discharge Canal
Bow
Suncook River
Allenstown
Hooksett
Hooksett Dam
93
3
3A
Legend
Monitoring Stations
EPA
United States Environmental Protection Agency New England
0
2,000
4,000 Ft
Created by EPA New England GIS Center
MapTracker ID: 4788
October 30, 2008


0
200 m
600 ft
A
mapquest
©2010 MapQuest Portions ©2010 NAVTEQ, i-cubed

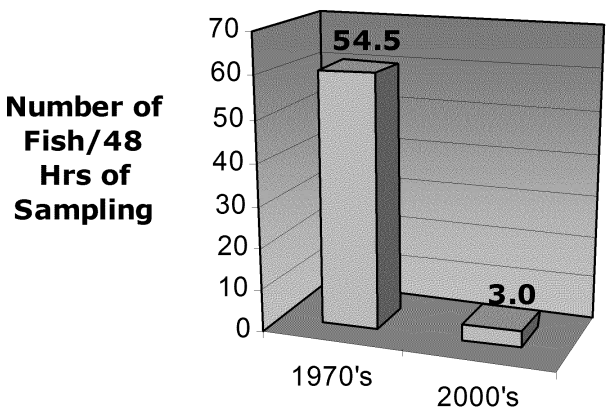
Merrimack Station's Thermal Effects

- **Thermal Discharge**
  - Forms a plume that can extend downstream 2.9 miles to the Hooksett Dam.
  - Thermal plume ranges bank to bank, covers roughly 50 percent of the entire surface area of the Hooksett Pool during summer low-flow conditions.
  - Since Hooksett Pool is shallow(≤10 feet), plume can affect 1/3 - 2/3 of the water column in the deeper areas and most of the shallows along the shorelines. This shallow shoreline habitat is important habitat for juvenile fish.
- **Merrimack River Water Consumption**
  - Under extreme low flow conditions, Merrimack Station redirects up to **76 percent** of the Merrimack River flow through the plant. The water is heated and discharged back into Hooksett Pool at temperatures up to **104F**, up to **24 degrees** warmer than ambient.
- **Fish Community**
  - The significant decrease in the relative abundance of temperature-sensitive fish species compared to more heat-tolerant species.
  - Comparison of similar fish community in an impounded section of the Connecticut River demonstrate that temperature-sensitive species such as yellow perch have successfully competed with introduced heat-tolerant species such as bluegill.

Thermal Harm

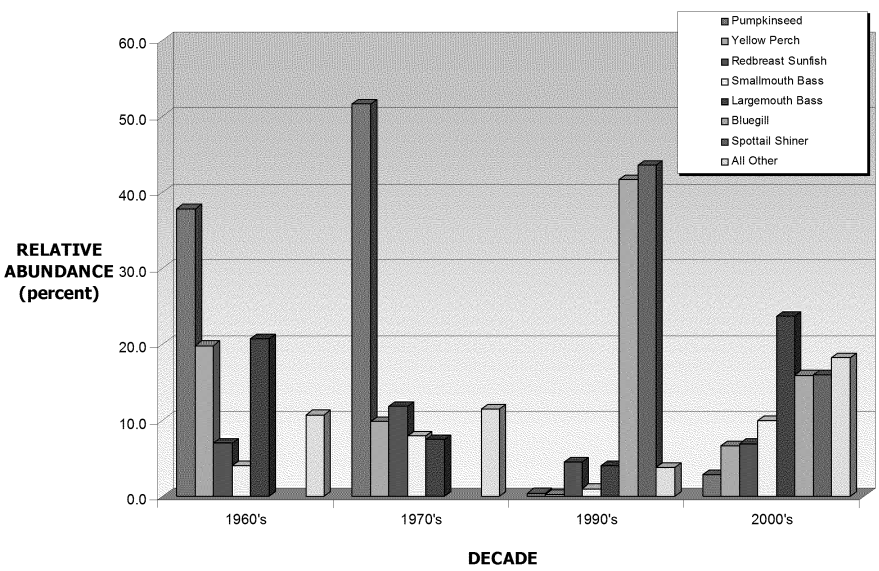
- The Hooksett Pool fish community has shifted from a mix of warm and coolwater species to a community now dominated by thermally-tolerant species;
- The abundance for all species combined that comprised the BIP in the 1960's has declined by 94 percent, and
- The abundance of some thermally-sensitive resident species, such as yellow perch, has significantly declined.

Change in Catch per Unit Effort of Hooksett Pool BIC Sampling

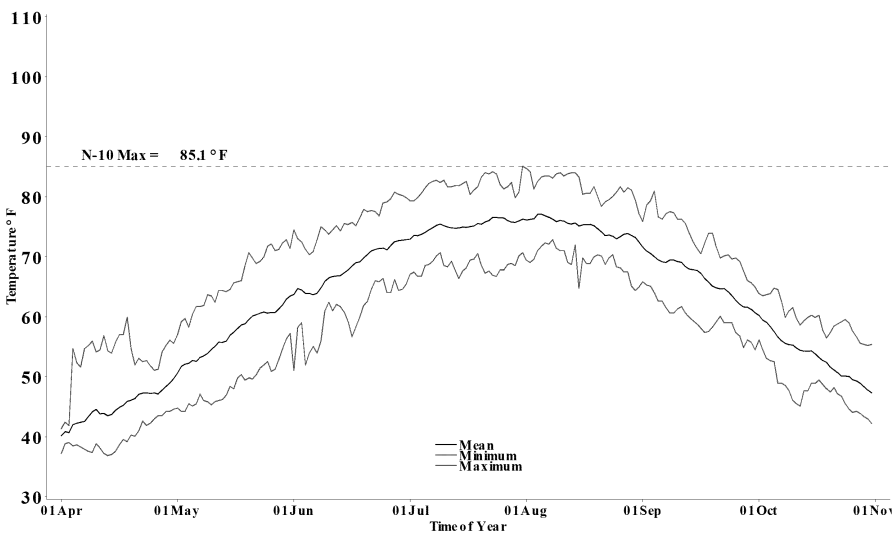


Changes in Resident Fish Community of the Hooksett Pool

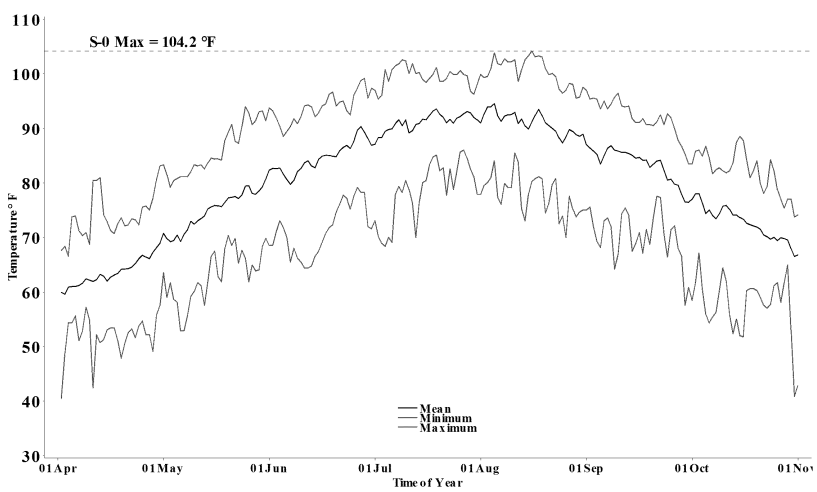
Electro-Fishing Data



Measured Averaged Daily Maximum, Minimum and Mean Water Temperature in the Upstream Ambient Zone (Station N-10) at Merrimack Station for 1 April – 31 October of 1984-2004.

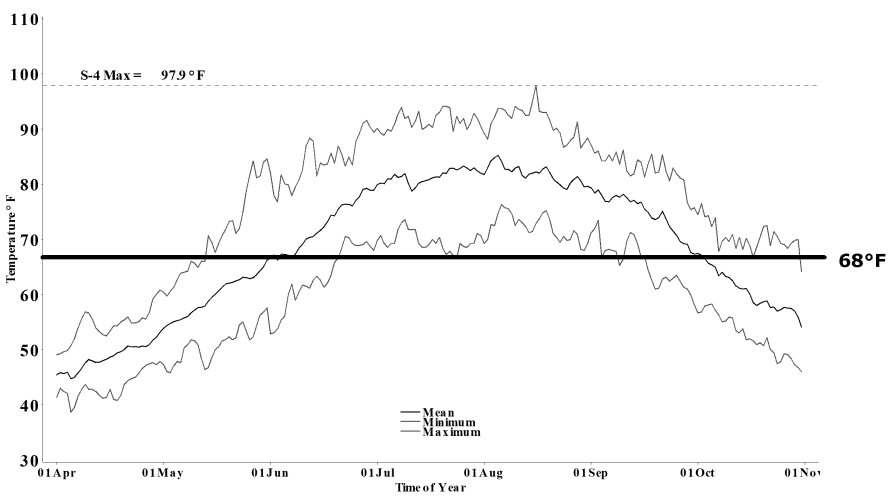


Measured Average Daily Maximum, Minimum, and Mean Water Temperature at the End of Merrimack Station's Cooling Canal (Station S-0) for April – 31 October of 1984-2004



Measured Average Daily Maximum, Minimum and Mean Water Temperature within Merrimack Station's Mixing Zone (Station S-4) for 1 April – 31 October of 1984-2004.

WITH OVERLAY OF CURRENT PERMIT TEMPERATURE "RECOMMENDATION"

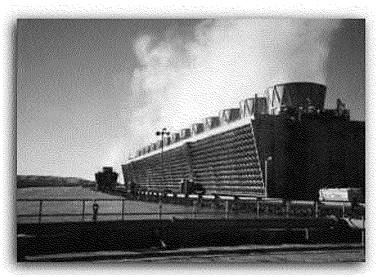


Staff conclusion: BAT for Merrimack Station is closed-cycle cooling

- Closed-cycle cooling on a year-round basis is the best performing technology
  - reduces thermal discharges by 95% or more
  - Is both technologically and economically available at Merrimack Station
    - Note PSNH has found mechanical draft towers to be technologically and economically feasible
    - But argues that natural draft towers would be technologically infeasible
- Cost is significant, but affordable to PSNH and its customers
  - and not unreasonable (in light of thermal discharge reductions)

What is closed-cycle cooling (closed-cycle recirculating systems)?

- Re-circulating systems, by recycling water, can reduce water withdrawals by at least 95 percent compared to once-through cooling.
- Cooling ponds and spray facilities may be used to augment the water-cooling and reuse.
- Closed-cycle, re-circulating systems are the most common cooling system in western states.
- Some power generating units use a combination of once-through and re-circulating systems.



For the Fact Sheet - Protective Temperature Limits

Time Period	Temperature*	Species/Life Stag Protected
APR 21 - MAY 11	*53.6°F (12°C)*	*Yellow Perch Spawning*
MAY 12 - MAY 30	*64.4°F (18°C)*	*Yellow Perch Egg Development*
JUN 1 - JUN 30	*73.4°F (23°C)*	*Yellow Perch Larvae*
JUL 1 - NOV 4	*77.1°F (25.1°C)*	*Yellow Perch Adult*
NOV 5 - APR 20	*46.4°F (8°C)*	*Yellow Perch Egg Gonad Development*

* When ambient river temperatures exceed thermal limit, a maximum ΔT of 1C shall be maintained between Station N10 and S0

Compliance with New Hampshire WQS

- EPA undertook a critical temperature analysis for the various species found in the river (and their various life stages)
- Identified the maximum in-stream temperatures tolerable while maintaining biological integrity of water

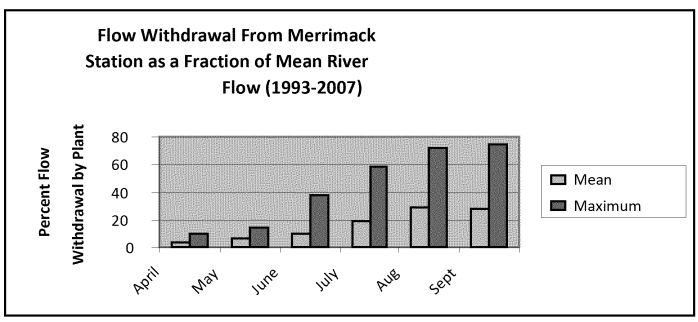
- Indicates that Merrimack Station could run open-cycle for approximately 8 months per year (mid-September to mid-May) and meet these critical temps
- Conversely, indicates that substantial thermal reductions would be needed about 4 months per year (mid-May to mid-September)
  - To meet limits would need either shutdowns or closed-cycle

Thermal Discharge Limits

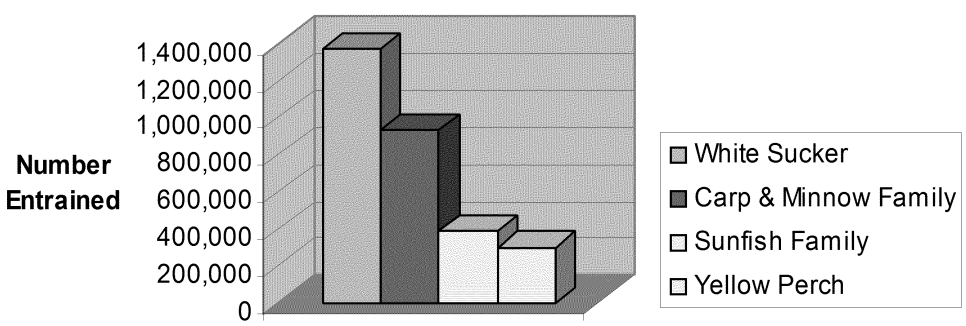
- Technology-Based
  - BAT developed on site-specific, BPJ basis
    - Year-Round closed-cycle cooling
- Water Quality-Based
  - Temperature limits that would, in essence, require seasonal closed-cycle cooling
- CWA § 316(a) Variance-Based
  - PSNH variance application requested limits based on year-round, open-cycle cooling
  - Region 1 rejected variance application due to harm from thermal discharge
- Final Permit limits?

CWA § 316(b) – CWIS Requirements

- Draft Permit – BPJ Decision
  - BTA for reducing –
    - Entrainment: Seasonal Closed-Cycle Cooling
    - Impingement: Screen, Fish Return System upgrade

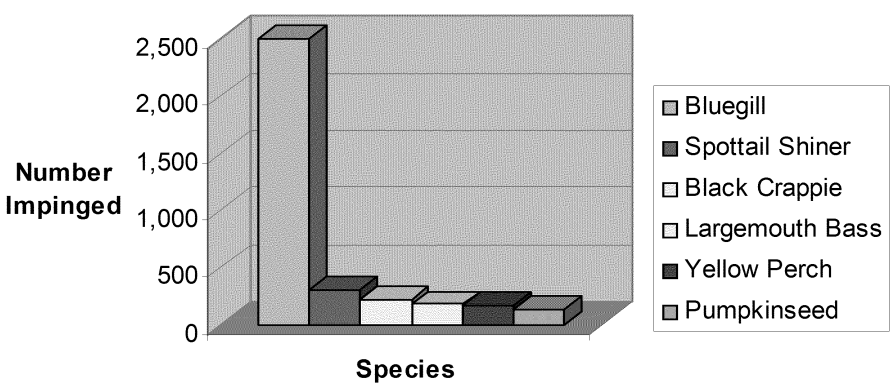

Flow Withdrawal From Merrimack Station as a Fraction of Mean River Flow (1993-2007)
Percent Flow Withdrawal by Plant
80
60
40
20
0
April
May
June
July
Aug
Sept
Mean
Maximum

Annual Estimated Entrainment Loss



- **All life stages combined (primarily larvae)**
- **Both generation unit's intakes combined**
- **Two year average**
- **Indicated species represents 90% of all larvae entrained**

Annual Estimated Impingement Loss

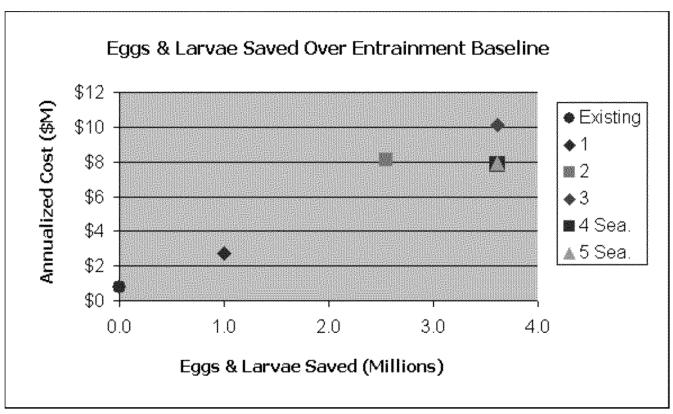


- **Both generation unit's intakes combined**
- **Two year average**
- **Indicated species represents 90% of all fish impinged**

Table 2

OPTION	Eggs & Larvae Saved Over Entrainment Baseline (Millions)	Fish Save Over Impingement Baseline (Thousands)	Annualized Cost ($M)	Option Description
Existing	0.00	0.00	$0.80	Unit 1 (OTC) Unit 2 (OTC)
1	1.07	2.97	$2.71	Unit 1(CCC)/UPGRD A Unit 2(OTC)/UPGRD B
2	2.55	4.10	$8.09	Unit 2(CCC)/UPGRD B Unit 1(OTC)/UPGRD A
3	3.62	4.77	$10.10	Unit1(CCC)/UPGRD A Unit 2(CCC)/UPGRD A
4 Sea.	3.62	3.99	$7.87	Unit1(CCC)/UPGRD A Unit 2(CCC)/UPGRD A
5 Sea.	3.62	4.22	$7.92	Unit1(CCC)/UPGRD B Unit 2(CCC)/UPGRD B

Figure 2


Eggs & Larvae Saved Over Entrainment Baseline
Annualized Cost ($M)
$12
$10
$8
$6
$4
$2
$0
0.0
1.0
2.0
3.0
4.0
Eggs & Larvae Saved (Millions)
Existing
1
2
3
4 Sea.
5 Sea.

Do intake limits satisfy NH WQS

- NH WQS apply to intake effects
  - "[t]hese rules apply to any person who … undertakes hydrologic modifications, such as … water withdrawals, or who undertakes any other activity that affects the beneficial use or the level of water quality of surface waters."
- Habitat and biological integrity criteria
  - All surface waters shall be restored to meet the water quality criteria for their designated classification including existing and designated uses, and to maintain the chemical, physical, and biological integrity of surface waters.
  - All surface waters shall provide, wherever attainable, for the protection and propagation of fish, shellfish and wildlife, and for recreation in and on the surface waters.
  - The surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.
  - Differences from naturally occurring conditions shall be limited to non-detrimental differences in community structure and function.
- Site-specific analysis
- No cost/benefit analysis

New 316(b) Rule - 40 CFR 125.94(d)

- Still BPJ for a facility like Merrimack

(d) *BTA standards for entrainment for existing facilities.* The Director must establish BTA standards for entrainment for each intake on a site-specific basis. These standards must reflect the Director's determination of the maximum reduction in entrainment warranted after consideration of the relevant factors as specified in § 125.98. … If the Director determines that the site-specific BTA standard for entrainment under this paragraph requires performance equivalent to a closed-cycle recirculating system as defined at § 125.92(c), then under § 125.94(c)(1) your facility will comply with the impingement mortality standard for that intake.

New Rule – 40 CFR 125.98(g)

- Ongoing Permit Proceeding – Not Need to Backtrack

(g) *Ongoing permitting proceedings*. In the case of permit proceedings begun prior to **[INSERT effective date of the final rule]** whenever the Director has determined that the information already submitted by the owner or operator of the facility is sufficient, the Director may proceed with a determination of BTA standards for impingement mortality and entrainment without requiring the owner or operator of the facility to submit the information required in 40 CFR 122.21(r). The Director's BTA determination may be based on some or all of the factors in (f)(2) and (3) and the BTA standards for impingement mortality at § 125.95(c). In making the decision on whether to require additional information from the applicant, and what BTA requirements to include in the applicant's permit for impingement mortality and site-specific entrainment, the Director should consider whether any of the information at 40 CFR 122.21(r) is necessary.

Compliance Schedules? – 40 CFR 125.94(b)(2) (and 125.98(c))

- (b) *Compliance with BTA standards*.

  * * *

(2) After issuance of a final permit establishing the entrainment requirements under § 125.94 (d), the owner or operator of an existing facility must comply with the entrainment standard as soon as practicable, based on a schedule of requirements established by the Director. The Director may establish interim compliance milestones in the permit.

FGD Issue

- NH Statute - 125-O:13(I)

  The owner shall install and have operational scrubber technology to control mercury emissions at Merrimack Units 1 and 2 no later than July 1, 2013. The achievement of this requirement is contingent upon obtaining all necessary permits and approvals from federal, state, and local regulatory agencies and bodies

- Economic Incentives

FGD Wastewater – Proposed BAT Limits

- Pollutants of Concern: mercury, selenium, and arsenic
- Draft Permit:
  - BAT selection on BPJ basis (consistent with statute, regs, guidance)
  - physical-chemical treatment & biological treatment
- Revised Draft Permit (currently out for comment):
  - VCE (zero liquid discharge)